CYCLES

VARIABLE SPEED-GEAR

FIVE methods have been employed for making the speed of the wheels variable with respect to the pedal crank-axle whilst the tricycle is in motion, so as to vary the power to suit the nature of the road.

(1) A set of change wheels may be thrown in and out of action as desired.

(2) An epicyclic train may be used which for one speed is locked together and moves as a single piece, and is set in motion for the other speed. The well-known crypto-dynamic two-speed-gearing was figured and described. In this an internally toothed wheel is keyed to the crank-axle. Connecting this and a loose pinion on the axle are four live pinions, the axles of which are attached to the chain-wheel. The internal wheel is fitted with a clutch, by which it can either be held stationary or keyed to the chain-wheel; when keyed to the latter the gear moves as one piece, and the higher speed is employed; when held stationary the live pinions roll round the centre wheel so that the chain-wheel travels less fast than the crank-axle, and then the greater power is obtained. This change can be effected by a striking lever.

(3) A third plan is to use two sets of chain-wheels and chains, either of which can be connected or disconnected at pleasure.

(4) Expanding chain-wheels can be used. Generally one only is employed and an idle pulley is provided for taking up the slack of the chain. A specimen was exhibited in which the pitch of the teeth is never altered.

(5) Another method of obtaining increased power is to use cranks with a variable throw. A diagram was shown of such a crank which could be changed in length by preventing it from rising by pressure when at the bottom of the throw; for at that time only is it free to turn on an eccentric, being locked by pawls and a gravitating bolt at any other position.

Position of Rider.—In every machine there is a certain position for the rider's seat, in respect both to the axle of the driving-wheel and to the crank-axle, which, on the level, will enable the rider to work to the greatest advantage. In ascending a hill the rider requires to be moved more forward, but he is in reality put further back, and the reverse is true when descending a hill. The most perfect contrivance for this purpose is the swing frame, which has been applied by Mr. Warner Jones to the Devon tricycle. The saddle and crank-axle are on the same frame, which is capable of rocking about the main axle and of being locked in various positions. By such means a rider is enabled to ascend a hill without leaning forward in the usual manner. A modification of the same arrangement by Mr. Griffiths was referred to.

Another method of varying the position depends on the use of a sliding base to the saddle-spring, which may be actuated by a lever and locked in one of three positions.

Hand-power Tricycles.—A few machines driven by the arms instead of by the legs have been made, but from the greater weakness of the arms they cannot compete with ordinary cycles, but are suitable only in special cases. Two machines, the Velociman and Oarsman were described. In the Velociman a pair of hand-levers are connected to the cranks of a second axle, which drives the main axle by a chain as usual, differential gear being employed to actuate the wheels. The rear steering-wheel is actuated by a lever carrying a cushion, which can be moved by inclining the body. In the Oarsman the action is similar to rowing. The rider sits on a sliding or a rocking seat, and pulls a cross-bar which is attached to a pair of driving ends which pass over pulleys connected with the driving wheels by clutches. During the return stroke the pulleys have their motion reversed by a spring.

Sociable Tricycles.—Of tricycles for two riders those in which the riders sit side by side are called Sociables, and those in which one is in front of the other, Tandems. The Sociable is merely an enlargement of the single form with some part in duplicate. Some can be converted into a single machine. In the Coventry rotary Sociable, since four wheels are on the ground, a joint has to be introduced to allow for the inequalities of the surface. In this machine each rider drives the wheel on his side only. An ordinary front-steering pattern of convertible tricycle was figured, in which, when one wheel is removed from the single form a second half-frame can be bolted on, while the axle of the added part is fitted where the wheel was removed, and the crank-axle of the added part is bolted to the crank-axle of the single part; thus the two riders drive through the same chain the box of the differential gear which drives each wheel equally.

Tandem Tricycles.—In these there is more scope for variety, and the different machines may be classed as follows:—

(1) The ordinary front or rear-steering tricycle in which the wheel-base is extended, so that the riders may be seated fore and aft of the differential-geared driving-axle without destroying the balance of the machine.

(2) The Humber tandem, in which the extra rider is seated in front of the driving-axle, but as nearly over it as possible, and communicates motion to it in a similar manner to the rear rider, who is seated further back than in the single machine so as to counterbalance the extra weight in front.

(3) A machine in which an auxiliary trailing frame is fixed in the rear of an ordinary front-steering tricycle. In order that the trailing frame may rise and fall with the inequalities of the road, and may follow properly when the machine is running round a curve, it is necessary for it to have both a transverse and a vertical joint between the two frames. A figure was given of a trailing frame with a chain to drive its own wheel which could be clamped to the back of any front-steering tricycle. With this arrangement there is no necessity to take off a chain when detaching. A special detachable chain for convertible tandems was shown.

Carrier Tricycles.—The most useful kind of tricycle of all is that for carrying a burden. First the "Coventry Chair" was exhibited. This consists of a Bath-chair in which the large wheels are driven by a rider at the back in the same way as the wheels of a tricycle. The driver also controls the steering and manipulates the brake. The passenger sits in a comfortable wicker chair. Though these machines cannot be driven with the freedom of an ordinary tricycle, yet when their weight and the fact that there is a passenger on board is considered, they travel with marvellous ease. Examples of journeys made were given.

Of goods carriers there are a large number of makes, but there is nothing in their construction to call for special comment; their success depends chiefly on the load being balanced as much as possible on the driving wheels. They are largely used by the Post Office for the parcels post, for the delivery of letters in rural districts. They are also largely used by newspaper offices for the distribution of papers, and by tradesmen for the delivery of goods.

Arrangement of Driving Gear.—Tricycles driven by rotary action may be subdivided according as the differential gear-box is in the centre or on one side, and according as the driving chain is in the centre or on one side.

In side-driving tricycles the loop frame is generally employed and the gear-box may be either at the centre or the side.

In central-driving tricycles the frame is usually of the T pattern. Here again the gear-box may be either at the centre or the side. Theoretically there is an advantage in the central position of the gear-box, as the friction

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[1] Continued from p. 135.

due to the bearings is equally distributed between the two wheels, whereas with side-gear one wheel only is retarded by this friction, but practically the difference is inappreciable. In central-driving machines the bearings must be so distributed as to prevent the main axle from bending under the pull of the driving-chain. The advantages of the T frame are its simplicity and lightness and the possibility of using adjustable cranks.

Width.—As the width of a tricycle varies between thirty-six and thirty-nine inches—excepting the Coventry Rotary, which from its special design can be made as narrow as twenty-seven inches—many arrangements have been devised for temporarily reducing the width, so as to enable a machine to pass through an ordinary doorway. Two plans only call for special notice, namely, folding frames and telescopic frames. A folding frame, when one or more pins are removed, can be folded up, but can still be wheeled along. In telescopic frames, which are always used with central-gearing, the frame and the axle on one side of the machine are made telescopic, so that by slackening a nut the parts slide over one another. A telescopic axle was shown.

Weight of Tricycle.—The proportionate weight of the several parts of a loop-frame front-steering tricycle were given.

COMPONENT PARTS OF CYCLES

Of the component parts of modern cycles the following alone call for special notice: wheels, bearings, frame, steering-gear, brake and pedals.

Suspension wheels, the first great improvement in cycle construction, are made with either solid or hollow rims, the latter being the lightest and strongest. In an ordinary wheel the spokes are radial; they are threaded through holes in the rim, and screwed into the edge of the flanges of the hub, being butt-ended or enlarged where the thread is cut upon them. The section of the rims is crescent-shaped. Hollow rims are made either from a tube by rolling it to form, or out of a single strip of steel plate bent to the desired section, in which case the edges lap over one another and are brazed together; or out of two or more strips of metal bent to form and brazed or sweated together.

Round rubber tyres are used, but with surfaces sometimes corrugated longitudinally, which gives a better hold on the road. The outer surface of the tyres is sometimes made of harder rubber to diminish the wear, while the elasticity of the inner and softer rubber saves the jolting of hard rubber alone. Tyres are usually fixed by cement, which when properly done is sufficient, but a wire passing through the centre of the tyre is used by some.

Tangent spokes are employed to give extra torsional rigidity to the wheel. The spokes, instead of being radial leave the hub nearly at a tangent alternately in opposite directions; sometimes a single piece of wire is threaded through the flange and the two ends made fast to the rim by nuts, but in that case they invariably give way first at the point of the double bend. Headed spokes passing transversely through the edge of the flange are now used.

One of the latest innovations in the construction of wheels consists in corrugating the spokes throughout their entire length, which gives a certain amount of elasticity to the wheel. At first sight it would appear that these corrugations should seriously diminish the lateral stability of the wheel; but as far as experience shows such is not the case. As, however, wheels so constructed have not been very long in use, it remains to be seen whether they will stand the wear and tear of the road.

Bearings.—The bearings of the wheels are now almost without exception made with anti-friction balls interposed between the moving parts. The most approved kind is that known as the Æolus, which can be adjusted concentrically. The balls lie round a groove on a collar on the axle, on the two sides of which they bear. They are enclosed within a concentric casing composed of two pieces, one of which screws within the other. Each of these has a hollow conical surface, between which the balls are free to run. One piece can be screwed in until there is as little shake as may be desired, and it may then be locked in position by a small toothed bracket. A diagram was given showing the section of the usual small wheel bearing also capable of concentric adjustment. The results of the experiments made by Mr. Boys on the wear of balls in ball bearings were given. He found that in running 1000 miles each ball lost in weight only 1/250 grain, which is equal to an actual surface wear of only 1/158,000 inch.

Frame.—The frames of both bicycles and tricycles are largely constructed of weldless steel tube. In the bicycle the front fork is made of tube tapered and worked into an oval section so as to give the greatest possible strength to withstand the severe torsional stress to which it is subject. The back-bone is left round, but is tapered, while the hind-wheel forks are usually made from a stamping in sheet steel.

The hollow framing of tricycles is usually circular, having a diameter of from 1 to 1¼ in. and a thickness of from 0·065 to 0·095 inch. The large number of solid parts necessary are usually made from wrought-iron or steel stampings. Malleable-iron castings are also largely used and are the cause of many of the breakdowns of machines. Owing to the great expense of dies the temptation to use these is strong. This expense, combined with the fact that the patterns of tricycles at present are frequently being changed, is the cause of the present high price of first-class machines.

Steering-gear.—The steering-gear may be dealt with under two heads: (1) the method of mounting the steering-wheel so that it may be turned for the purpose of steering; (2) the method of controlling the wheel.

(1) The steering-wheel of all bicycles and of most tricycles is mounted in a fork, at the top of which is a "head" by which the fork is attached to the frame. In the head is the joint to allow the steering-wheel to be turned. The "Socket" and the "Stanley" head were described and a figure given of an improved "Stanley" head in which, instead of cones, balls are used to allow of free motion between the head and the central pin. A figure was given of another form of Stanley head in which a central pin is employed.

The steering-wheels of tricycles are not always mounted in forks. Among other methods that employed in the "Quadrant" tricycle was described, and another in which a large skeleton hub carries within it a small head actuated by a lever from the outside.

(2) On an ordinary bicycle the steering is controlled simply by a handle bar rigidly fixed to the fork.

Tricycles have their steering actuated usually by the rack and pinion; a handle-bar as used on a bicycle is also employed either connected directly with the fork or through levers.

Owing to the sensitiveness of this mode of steering, mechanism has been contrived which tends to keep the steering-wheel to a straight course. The most effectual is that employed on the Humber make of front-steering tricycle. A V-shaped cam on the steering-rod lies in a corresponding recess on the top of the socket of the steering-spindle and is held down by a spring. When the machine is steered the spring is compressed by the action of the cam, and so it tends to bring the wheel back to the straight line.

Brake.—There are but two varieties of brake; the spoon- and the band-brake. The spoon-brake consists of a spoon-shaped lever so pivoted that it can be pressed against the tyre of the large wheel in the bicycle or the two wheels of a tricycle.

The band-brake, almost exclusively used on tricycles, consists of a band of steel lined with leather encircling a drum in the driving-axle. By a hand-lever this can be tightened with great force. In some central-geared tricycles a band-brake can be applied with the foot to the crank-axle.

Pedals.—When bicycle cranks are used the pedals are mounted on pedal pins bolted to the cranks. With cranked axles they are made in two halves. Ball bearings are frequently employed. Both rat-trap and rubber pedals are made: the latter are more slippery than the former, but absorb more vibration and so are more comfortable. The combination pedal with rat-trap plates on one side and rubber on the other is due to the author. A common cause of danger in bicycle riding is the slipping of the feet from the pedals when driving with much power, which puts the weight so far forward as to throw off the rider in front. Pedals to grip the feet have been devised, but some forms are apt to hold the feet so firmly as to make a sudden dismount occasionally impossible. The author has invented a pedal in which by bell-crank levers the foot is only held when pressure is exerted.

Fittings, &c.—Of the fittings and accessories the varieties are far too extensive for enumeration; but many display an amount of ingenuity that will well repay an inspection of them. The manufacture of these fittings forms separate trades, which employ a large amount of capital and labour.

The Chairman having complimented the author on the excellence of his paper, invited discussion.

Mr. C. Vernon Boys, referring to the undoubted going powers of the small Safeties, thought that in addition to the reason given in the paper the facts that the wind resistance was enormously reduced and that the rider could work in a position of comfort, without straining himself to ride as high a wheel as possible, had a great deal to do with the observed result. He thought that on a racing path the wind resistance of the spokes was the chief opposition to the motion of the machine.

He pointed out that the method of turning the Otto as described by the author, though employed by some, was essentially bad, tending to rub the tyres off one of the wheels, and explained the perfect method by which the wheels are made to turn simultaneously in opposite directions, by which no strain is put upon the tyres and only half the space is required for turning.

He thought too much preference had been given the clutch as compared with the differential gears for driving tricycles, and pointed out that in starting round a curve owing to the fact that the wrong wheel—the inner one—alone drives, more strain is thrown upon the steering-wheel, causing it to slip, than it ever experiences in ordinary riding when one wheel of a differentially-geared machine meets with greater resistance from mud or other causes than the other.

He mentioned the fact that Mr. Burstow, the inventor of the centre-cycle, had shown him nearly two years ago a double-acting clutch such as the author considered to be even more perfect than the differential gear, but he did not know how it was constructed.

Passing on to the Oarsman tricycle, Mr. Boys said that though apparently a hand-worked machine it was in reality driven chiefly by the muscles of the legs and body, and the stroke was only completed by the arms; and also that though a clutch-driven machine it had the advantages of a differentially-geared machine, in that when turning a corner the two cords could be pulled to different extents, and each wheel could at all times be driven.

He gave his experience of the elastic spokes. Since Christmas he had ridden a pair of wheels 3,800 miles, and had tested them most severely, but as yet they showed no signs of becoming untrue or losing their elasticity.

He had made further tests of the wear of balls, letting them run 1000 miles without being opened, after which he found that the wear was about one-fifth the rate of that previously observed. This, he considered, went to show that the wear, such as it was, was almost entirely due to a very small amount of grit which it is impossible to prevent from entering the bearing from the screw however carefully it may be cleaned. However, the result last obtained showed that the loss of weight of each ball in travelling 1,000 miles, during which it turned on its own axis about 1,400,000 times was less than 1/1000 grain. This, he thought, showed that those who found fault with ball bearings did so very rashly.

Mr. Sampson referred to a machine shown at the Inventions Exhibition on the lines of the Otto, but driven with a chain and with definite worm-gear for steering, which was worthy of attention.

Mr. Dalby, speaking as a rider, said he was sure that the author of the paper had not set the invention of the balance gear at its true value, that he had done special pleading on behalf of the clutch system After severely criticising the arguments of the author, he attributed the poisibility of the modern tricycle mainly to the balance gear.

Mr. F. Warner Jones thought that more might have been said on the principles of cycle construction. The paper had been mainly descriptive of machines, and very little of first principles was to be found in it.

He agreed that the wind resistance was so much less felt on the small safeties than on a full-sized machine, that this should be considered an important factor in the cause of their good qualities. But he did not quite agree with Mr. Boys as to the way in which this acted. In any case the seat must be about seven inches behind the pedal axle to enable the rider to work in a proper position. With a saddle so placed on an ordinary bicycle the position became dangerous when descending a hill, but owing to the construction of the safety bicycles this position could be attained with perfect safety, the rider being more between the wheels. On a high machine the wind acted with a greater leverage, throwing more pressure on the hind-wheel in proportion than in a Safety.

The Safety bicycles with the steering-wheel in front were safer than the others owing to their greater length, and the fact that the rider was so far back, but they were not so fast, as less weight was on the driving-wheel. The rider could not be placed far enough back to put as much weight on the driving-wheel unless the pedal axle were divided. By adapting the swing frame with the divided pedal axle to such a class of machine, as much weight as desired could be placed upon the driver, and the advantages of the dwarf bicycles and of the Otto secured in one machine.

Concerning the Otto there seemed an anomaly—that they were better hill climbers when the wheels were as high as 56 in. than when smaller. As it was necessary for the centre of gravity to be over the points where the wheels touched the ground, there was a limit to the steepness of hill which could be surmounted.

He quite agreed with Mr. Boys as to the good qualities of the elastic spokes. He considered they were correct in principle.

Mr. Boys showed that even in the case of the steepest hills the amount by which the points of contact of the wheels with the ground were advanced was so small as to produce none of the effects supposed by Mr. Jones. In fact the hill-climbing power of the machine was perfectly well known.

Mr. Phillips felt sure that the slow pedalling was a far more important factor than the diminished wind resistance in the cause of the excellence of the Safeties. He had not intended to represent that the clutch gear was as good as the differential, but that at present the differential was greatly superior; he however believed that some device of the kind that he had spoken of—a perfect and instantaneous double-acting clutch—would be better than either.

He had not seen Mr. Burstow's clutch mentioned by Mr. Boys.

In speaking of the loss of power due to perpetually bending steel driving bands he did not refer to the very thin bands of the Otto, but to driving bands with holes to fit over pins some four or five times as thick.

The Chairman considered it an open question whether the path of a bicyclist were really wavy as theory seemed to show. He had often watched a bicyclist and it was almost impossible to believe that he did not travel in a straight path. He thought this question worthy of more attention. He had heard it asserted that no advantage could be gained by the use of artificial cycles over natural legs, but it must be remembered that legs were implements fitted for other purposes besides running, such as jumping and climbing. Again, no one supposed that a horse could carry on his back such a load as he could easily draw in a carriage on a road; here the extra weight of the carriage corresponded to the addition of the bicycle.

As in many other industries, bicycle and tricycle construction depended to a large extent for its success upon the perfection of many details of construction; as instances of important details he referred to rubber, steel wire, steel stampings, and driving-gear. Having made some remarks on the necessity of good roads he expressed the opinion that in time cycle ways might be laid down with advantage.

It was a mistake to suppose that cycling was only suitable for the young and active; people of all ages and conditions might enjoy the benefits of the wheel. The advantage of a sound machine to a labouring man, or of a hand-driven machine to a lame man, was inestimable, while invalids could even enjoy a run to the seaside in a Coventry-chair without the annoyance of cabs, railway stations, and trains. Having proposed a hearty vote of thanks to Mr. Phillips for his paper, he brought the proceedings to a close.

ALFRED TRIBE

On November 26 died, after a very short illness, Mr. Alfred Tribe. He was born in London forty-six years ago in humble circumstances, and his first acquaintance with science seems to have been obtained as a boy at the Royal College of Chemistry. While waiting upon the students there he acquired whatever knowledge he could, and repeated in a back kitchen at home many of the experiments he had seen them perform. Prof. Hofmann, pleased with his desire for knowledge, gave him every encouragement and assistance in his power. At the age of sixteen he entered into the service of Dr. Medlock, then of Dr. Forbes Watson, and afterwards he assisted Prof. Williamson, of University College. He then went to Dr. Bernays, who after some time induced him to spend a year at Heidelberg under Prof. Bunsen, and kept his place at St. Thomas's Hospital open for him while he was away. On his return he continued to act as laboratory assistant and Demonstrator of Chemistry.

Twenty years ago he became my private assistant, and remained head of my laboratory till his death. During the same time he held the Lectureship on Metallurgy to the Medical School of the National Dental Hospital, and since 1874 he has been Lecturer on Chemistry and Director of Practical Chemistry in Dulwich College.

He became successively a Fellow of the Chemical Society, of the Institute of Chemistry, and of the Society of Chemical Industry.

Mr. Tribe was pre-eminently a scientific investigator. He loved patient and original research, and all his work was most carefully and honestly done. He published a large number of papers, some in his own name, and others in conjunction with myself. His first paper was on Sulphide of Ammonium, his second on the Expansion of Bismuth at the Freezing-point. His more important inquiries were connected with the occlusion of hydrogen by copper and the rarer metals, and especially a series of experiments on the distribution of the electricity in an electrolyte traversed by a current. The curious and suggestive results of this investigation appear in abstract in the *Proceedings* of the Royal Society for January and June, 1881, but they are most fully expounded, with coloured illustrations, in the second edition of Mr. J. E. H. Gordon's Treatise on Electricity and Magnetism."

His most important research in conjunction with myself is contained in a series of papers on the Copper-Zinc Couple, published principally in the *Journal* of the Chemical Society. He was the first to observe the greatly enhanced chemical power of zinc when covered with spongy copper. Whatever value there was in this extended research was due to his original suggestions, as much as to his careful manipulation. The same credit is due to him with regard to the series of papers on the aluminium-iodine reaction, the last of which was read only the night before he was taken ill. His discovery of these two new methods of acting upon chemical compounds was productive of many new substances, including the aluminium alcohols.

In addition to these chemical inquiries, we worked together on some electrical matters—describing an air-battery, that is, one in which the oxygen of the air took part; some experiments on thermal electrolysis; and, more particularly, the chemistry of the secondary batteries of Planté and Faure. The results of this investigation were first made known through the pages of NATURE, and were afterwards collected together in a separate treatise.

As a teacher of science, Mr. Tribe was very successful. He had the art of communicating his own enthusiasm to his laboratory students, and many of them have distinguished themselves since at the Universities or elsewhere. Only the week before his death he had the satisfaction of knowing that his favourite science was to receive a more worthy share of attention in the Dulwich College.

At these pursuits Mr. Tribe worked earnestly and continuously, being little known beyond his laboratories and his home. His widow, and four surviving children, together with a small circle of intimate friends, will however long remember the thorough uprightness of his character, and the self-denying purpose of his life.

J. H. GLADSTONE

JORDAN'S PHOTOGRAPHIC SUNSHINE RECORDER

Up to the present time the only instruments in general use for registering the duration of sunshine are modifications of the original apparatus invented by the late Mr. J. F. Campbell, of Islay, in 1853, the essential part of which consists of a clear glass globe capable of condensing the solar rays sufficiently to burn a trace on a card placed within its focal range. New forms of instruments have, however, been lately devised, and in the International Inventions Exhibition there were exhibited two Sunshine-recorders differing entirely from those hitherto used, the results being obtained by means of photography. Prof. McLeod's instrument was described in NATURE (vol. xxxi. p. 319), and we now give particulars of Mr. Jordan's photographic Sunshine-recorder. This instrument is of very simple construction. The working part consists of a cylindrical box or dark chamber $2\frac{1}{2}$ inches diameter and $3\frac{1}{2}$ inches long, mounted on a suitable stand having the means of adjustment to suit the latitude of the station where used. This cylinder is pierced with two small rectangular apertures or knife-edged slits, and, being placed in a position facing south,